Severe Maternal Morbidity among Undocumented Migrant Women in the PreCARE Prospective Cohort Study

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1 **Title Page**

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3 cohort study

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28 Short title: Migrants' legal status and severe maternal morbidity

1 **Abstract**

2 ***Objective:*** In Europe, migrant women, especially from sub-Saharan Africa, have higher risks

3 of adverse maternal outcomes than non-migrants. Legal status, a component of migrant

4 condition, may be an important, and potentially actionable, risk factor. We aimed to assess the

5 risk of severe maternal outcomes among migrant women, considering both their legal status

6 and birthplace.

7 ***Design:*** Prospective cohort study.

8 ***Setting:*** Four maternity units around Paris in 2010–2012.

9 ***Sample:*** 9599 women with singleton pregnancies.

10 ***Methods:*** Legal status was categorized in four groups: reference group of non-migrant native

11 Frenchwomen, legal migrants with French or European citizenship, other legal migrants with

12 non-European citizenship, and undocumented migrants. The risk of severe maternal morbidity

13 was assessed with multivariable logistic regression models according to women's legal status

14 and birthplace.

15 ***Main Outcome Measure:*** Binary composite criterion of severe maternal morbidity.

16 ***Results:*** Undocumented migrants had resided less time in France, experienced social

17 isolation, linguistic barriers and poor housing conditions more frequently, and had a

18 prepregnancy medical history at lower risk than other migrants. The multivariable analysis

19 showed they had a higher risk of severe maternal morbidity than non-migrants (33/715 (4.6%)

20 versus 129/4523 (2.9%), adjusted odds ratio [aOR] 1.68; 95% confidence interval [CI] 1.12–

21 2.53). This increased risk was significant for undocumented women from sub-Saharan Africa

22 (18/308 (5.8%) versus 129/4523 (2.9%), aOR 2.26; 95%CI 1.30–3.91), and not for those born

23 elsewhere (15/407 (3.7%) versus 129/4523 (2.9%), aOR 1.44; 95%CI 0.82–2.53).

24 ***Conclusion:*** Undocumented migrants are the migrant subgroup at highest risk of severe

25 maternal morbidity, while the prevalence of risk factors does not appear to be higher in this

26 subgroup. This finding suggests that their interaction with maternity care services may be non-

27 optimal.

1 **Introduction**

2 Europe has been experiencing a migration and humanitarian crisis for several years. The

3 proportion of migrants among childbearing women in these countries is increasing.[1] In 2019,

4 24.6% of women who gave birth in France were born elsewhere.[2] Migrant women have a

5 higher risk of adverse pregnancy outcomes than women born in their host country,[3–7] including

6 higher risks of maternal mortality and severe morbidity.[8–11] Nonetheless, disparities exist

7 between migrant subgroups, particularly according to maternal birthplace. In several high-

8 income countries, migrant women from sub-Saharan Africa appear to be the most vulnerable

9 group; their risk of adverse maternal outcomes ranges from two to four times higher than that

10 of native-born women.[6,10,12–16] In addition to the question of social justice, this situation presents

11 organisational and cost challenges for the host health system.

12 The mechanisms explaining these social inequalities in health remain unclear. Adding to

13 geographical origin, legal status may be an important, and potentially actionable, risk factor.

14 The main focus of the available literature, although very limited, has been so far asylum

15 seekers and refugees, because these subgroups of migrants, with their traumatic migration

16 histories, were expected to have the worst outcomes and have been shown to be at higher risk

17 of severe maternal morbidity than native-born women.[17,18] Nonetheless, asylum seekers and

18 refugees benefit from a status that is supposed to provide them with some social protection,

19 while undocumented migrants, i.e., those without any permit for legal residence, are likely to

20 be at even greater risk because of the many barriers they face in their interactions with the

21 health system, including individual and institutional discrimination, and the lack of social

22 protection.[5,19,20] The size of this subgroup of migrants is growing in Europe.[21] In France,

23 undocumented migrants can claim free care under the state medical assistance (AME) system.

24 They can apply for it 3 months after their arrival, and it is valid two months after the application.

25 Recent data showing a high frequency of inadequate antenatal care among undocumented

26 migrants further supports the hypothesis that legal status plays a role.[22] Exploring if and how

27 legal status is associated with differential maternal outcomes might provide insights into the

28 causal mechanisms of health disparities among migrant women, in particular those related to

29 geographical origin, and into the possibilities for preventive interventions.

30 The French multicentre prospective PreCARE cohort, as one of the few databases including

31 the legal status of migrant pregnant women, offers the opportunity to explore this question.

32 Thus, our aim was to assess the association between women's migrant profile, considering

33 both their legal status and birthplace, and severe maternal outcomes.

1 **Methods**

2 *Population*

3 The French PreCARE multicentre prospective cohort study took place in four university

4 hospital maternity units in the northern Paris area from October 2010 to May 2012.[22,23] This

5 geographical area is characterised by its high prevalence of social deprivation and its

6 multicultural population.

7 The study included all pregnant women ≥ 18 years old, registered and giving birth in these

8 hospitals. This analysis covered the study population of women who gave birth after 21

9 completed weeks of gestation. It excluded women who finally gave birth in a nonparticipating

10 hospital, were lost to follow-up, or had completely empty questionnaires.

11 The regional ethics review board, CPP-Ile-de-France III (No. 09.341bis, 19 November, 2009),

12 and the CNIL (Commission Nationale Informatique et Liberté) approved this study. Each

13 woman provided oral informed consent, in accordance with French law. Women were not

14 involved in the development of the research.

15 *Data collection*

16 Data on maternal birthplace, legal status, social and demographic characteristics (age,

17 deprivation index, education level, social welfare coverage at inclusion, length of residency,

18 and linguistic barrier) were collected by self-administered questionnaires at inclusion and

19 repeated during the postpartum period before discharge. To enable the inclusion of women

20 not speaking French fluently or who could not read or write, these questionnaires were

21 available in the four principal languages of the main region of origin of the residents, and a

22 research assistant or interpreter helped in their completion when needed. Data on women's

23 medical history and information about their pregnancy, labour, delivery and postpartum period

24 were collected by research assistants and practitioners (midwives and obstetricians) with

25 specific questionnaires completed from the medical files in the postpartum period before

26 discharge.

27 *Definition of women's legal status*

28   The exposure of interest, the women's legal status, was first categorised in four groups: 1)

29   non-migrants, i.e., women born in France, as the reference group, 2) legal migrants with

30   French or other European Union-27 citizenship, 3) other legal migrants, with non-European

31   citizenship, and 4) undocumented migrants. Migrant women with French or European

32   citizenship were born outside France and reported a French or other European citizenship,

33   and were thus automatically legal. Other legal migrants were born outside France and held a

34   residence permit, or a temporary residence permit, or a short- or long-term tourist visa, issued

35   by French or European authorities. Asylum seekers and women with refugee status were

36   categorised as other legal migrants. Undocumented migrants were born outside France, had

37   a non-European citizenship, and were awaiting a decision about their legal status

38   (regularisation and residence permit), or on expiry of their visa or residence permit, or with a

39   negative response to their application for regularisation. Details on the various categories of

40   legal status are provided in Table S1. Information about legal status was self-reported during

41   the inclusion questionnaire, administered either by the woman herself or by a research

42   assistant or interpreter when needed. If this information was missing, it was extracted from the

43   postpartum questionnaire. To further consider the women's birthplace together with their legal

44   status, the exposure of interest was also analysed as a seven category variable combining the

45   two dimensions of migrant status: 1) non-migrants, 2) legal migrants with French or European

46   citizenship, born outside sub-Saharan Africa, 3) legal migrants with French or European

47   citizenship born in sub-Saharan Africa, 4) other legal migrants born outside sub-Saharan

48   Africa, 5) other legal migrants born in sub-Saharan Africa, 6) undocumented migrants born

49   outside sub-Saharan Africa, and 7) undocumented migrants born in sub-Saharan Africa.

50   ***Definition of severe maternal morbidity***

51   The outcome was severe maternal morbidity, as a binary composite variable. It was defined

52   by at least one of the following complications at or after 21 completed weeks of gestation and

53   up to 42 days postpartum: severe hypertensive disorder of pregnancy (presence of severe

54   preeclampsia [systolic blood pressure > 160 mm Hg, diastolic blood pressure > 110 mm Hg,

55   or hypertension with general signs, and one or more of the following: proteinuria >3.5 g/24

56 hours, serum creatinine >100 μmol/l, diuresis <20 ml/hour, haemolysis, aspartate

57 transaminase > 3N, thrombocytopaenia <100 000/mm3, or before 32 weeks], eclampsia or

58 placental abruption in the context of a pregnancy-related hypertensive disorder), severe

59 postpartum haemorrhage (second-line uterotonic treatment associated with transfusion of at

60 least two units of packed red blood cells, and/or uterine artery ligation, and/or uterine

61 compressive sutures, and/or embolisation and/or hysterectomy), grade 3 or 4 perineal trauma,

62 surgical reintervention, maternal admission to intensive care unit, deep venous thrombosis or

63 pulmonary embolism, convulsions (excluding eclampsia), placental abruption except for

64 severe hypertensive disorder of pregnancy, uterine rupture, diabetic ketoacidosis, severe

65 sepsis (sepsis with organ failure), haemorrhagic shock, or maternal death.[23]

66 ***Definition of covariables***

67 Maternal social deprivation was defined at the beginning of pregnancy by a previously

68 described[22] quantitative deprivation index that was the sum of four dimensions of deprivation:

69 social isolation, poor or insecure housing conditions, no standard healthcare insurance, and

70 no work-related household income.

71 High-risk pregnancy was defined in accordance with French guidelines by the presence of at

72 least one of the following condition at the beginning of pregnancy: history of cardiac disease,

73 hypertension, diabetes, venous thrombosis, pulmonary embolism, Graves' disease, asthma,

74 homozygous sickle cell disease, anaemia, thrombocytopaenia, coagulation disorder, systemic

75 disease, nephropathy, HIV infection, previous late miscarriage, previous preeclampsia,

76 previous fetal growth restriction, previous preterm delivery, previous fetal death or neonatal

77 death.[24]

78 ***Statistical analysis***

79 We described the women's baseline characteristics and their rates of severe maternal

80 morbidity according to their legal status, expressing qualitative variables as percentages and

81 quantitative variables as their medians and interquartile ranges. The statistical tests used were

82 the Kruskal–Wallis test for medians, and the chi-square test (or Fisher's exact test, as

83 appropriate) for qualitative variables.

84   We used logistic regression models to assess the association between legal status and severe

85   maternal morbidity. We represented causal assumptions between legal status, severe

86   maternal morbidity, and covariates with a directed acyclic graph to depict the exposure-

87   outcome relations with confounding and intermediate factors (Figure S1). This graph helped

88   to select variables that are confounders (i.e., variables associated with both the exposure,

89   which is legal status, and the outcome of severe maternal morbidity, and not on the causal

90   pathway between legal status and severe maternal morbidity) and those that do not qualify as

91   confounders (especially intermediate factors on the causal pathway).[25] The main regression

92   model included only confounders: maternal age, education level, number of previous

93   pregnancies, and maternity unit of delivery. Antenatal care utilisation was considered as

94   intermediate factor and thus not included in the model. The linearity of the association of the

95   continuous variables (age and number of previous pregnancies) with severe maternal

96   morbidity was tested. A secondary analysis with the seven-category exposure variable

97   considering both the women's legal status and place of birth was conducted with the same

98   strategy.

99   A sensitivity analysis was performed after the exclusion of women who had arrived in France

100   less than 12 months before delivery and who started their antenatal follow-up in France after

101   14 weeks of gestation, to avoid a potential bias related to norms of care outside France.

102   The proportion of women with missing data in the multivariable model was 4.0%. Multiple

103   imputation using chained equations (25 datasets) was performed to handle the missing data,

104   assumed to be missing at random.[26] The results are presented with imputed data as adjusted

105   odds ratios (aOR) with their 95% confidence intervals (95% CIs). All statistical tests were two-

106   tailed, and the threshold for statistical significance was set at a probability value of <0.05.

107   Analyses were performed with STATA software, version 13.1 (Stata Corporation, College

108   Station, TX, USA).

Results

Among the 10 576 women asked to participate in the Pre-CARE study, 10 419 agreed (98.5%). After the exclusion of women mistakenly included (n = 60), or withdrew their consent (n = 6), gave birth before 21 completed weeks of gestation (n = 135) or in a nonparticipating maternity unit (n = 209), were lost to follow-up (n = 378), or had missing questionnaires (n = 32), the analysis included 9599 women (Figure S2).

In the analysis population, 4523 women were born in France (47.1%), 1555 were legal migrants with French or other European citizenship (16.2%), 2806 were other legal migrants (29.2%) and 715 women were undocumented migrants (7.4%), accounting for 14.1% of all migrant women. Table 1 summarizes the women's baseline characteristics by legal status. Undocumented migrants had lived less time in France and experienced linguistic barriers, social isolation and poor housing conditions more frequently than other categories of migrants. Ninety-nine percent (637/715) of undocumented migrants have at least 1 criterion of maternal social deprivation compared to 19% (858/4523) of non-migrants. On the other hand, they were younger (398/715 (55.7%) were under 30 years old versus 2110/4523 (46.7%)) and less frequently at high risk at the beginning of pregnancy than either the native-born Frenchwomen (124/715 (17.3%) versus 925/4523 (20.5%) or the other categories of migrants. One quarter of the undocumented migrants were not covered by state medical assistance at inclusion, this proportion was 17.6% among those who arrived in France at least 5 months before inclusion (and were thus legally eligible for this assistance). The proportion of women born in sub-Saharan Africa was higher among undocumented migrants (43.1%) than in the other migrant groups (31.3% for other legal migrants and 24.5% for legal migrants with French or European citizenship). Undocumented migrants had the highest prevalence of caesarean deliveries of the four groups (Table 1).

Severe maternal morbidity occurred in 304 women (3.2%) overall. The main maternal complication was severe pregnancy-related hypertensive disorders (1.0%) (Table 2). This

27 predominance was particularly marked in undocumented migrants born in sub-Saharan Africa

28 (2.9%) (Table S2).

29 In the multivariable analysis, undocumented migrants had the highest risk of severe maternal

30 morbidity (33/715 (4.6%) versus 129/4523 (2.9%), absolute difference 1.7% (95%CI 0.4%–

31 3.6%), aOR 1.68; 95% CI 1.12–2.53), compared with the reference group of non-migrant

32 women (Table 3). When considering the women's place of birth with their legal status, this

33 higher risk was significant only for undocumented migrants born in sub-Saharan Africa (18/308

34 (5.8%) versus 129/4523 (2.9%), absolute difference 2.9% (95%CI 0.8%–6.2%), aOR 2.26;

35 95% CI 1.30–3.91), not for those born elsewhere (15/407 (3.7%) versus 129/4523 (2.9%), aOR

36 1.44; 95% CI 0.82–2.53). A similar pattern of associations, although less marked, was found

37 for other legal migrants (101/2806 (3.6%) versus 129/4523 (2.9%), aOR 1.35; 95% CI 1.03–

38 1.79) overall compared with natives, with a frankly higher risk for those born in sub-Saharan

39 Africa (34/877 (3.9%) versus 129/4523 (2.9%), aOR 1.62; 95% CI 1.07–2.47) than those born

40 elsewhere (67/1929 (3.5%) versus 129/4523 (2.9%), aOR 1.33; 95% CI 0.97–1.82) (Table 3).

41 No significant difference was found for legal migrants with French or European citizenship

42 (aOR 0.94; 95% CI 0.7–1.4) compared with non-migrants, regardless of maternal birthplace

43 (Tables 2 and 3). Results were similar in the complete case analysis (Table S3).

44 The sensitivity analysis excluding women who arrived in France less than a year before

45 delivery and who started their antenatal follow-up in France after 14 weeks of gestation, found

46 similar associations, in particular, an increased risk of severe maternal morbidity in

47 undocumented migrants from sub-Saharan Africa (aOR 2.80; 95% CI 1.42–5.53) compared

48 with women born in France (Table S4).

1 **Discussion**

2 *Main Findings*

3 Undocumented migrants constitute a significant subgroup of migrant women in this cohort.

4 They had resided in France for less time, had experienced linguistic barriers, social isolation,

5 and poor housing conditions more frequently than other categories of migrants, and had an at-

6 risk medical history before pregnancy less often. They had a higher risk of severe maternal

7 morbidity than French-born women. When place of birth was considered with their legal status,

8 the risk was higher only for undocumented migrants born in sub-Saharan Africa. Similar but

9 less strong associations were found for other legal migrants but not for those with French or

10 European citizenship.

11 *Strengths and Limitations*

12 To our knowledge, this study is one of the very few based on prospective multicentre data able

13 to clarify the association between legal status and maternal health outcomes, as information

14 about legal status is generally unavailable in most databases. We chose to examine this status

15 in four groups to understand more clearly the specific impact of lacking legal status. Similarly,

16 we chose to isolate women born in sub-Saharan Africa from those born elsewhere because

17 previous reports have shown the highest risks of inadequate antenatal care utilisation and

18 morbidity in this subgroup.[6,10,12,14–16,22] The large sample of migrant women and in particular of

19 undocumented migrant women, with very few missing data, provides adequate statistical

20 power. The rate of missing data in the study population was low and, as demonstrated by the

21 comparisons of results obtained by the analyses with imputed data and with complete cases,

22 had a very limited impact on the results (Table S3). The data collection method, especially the

23 availability of the questionnaires in four different languages and the availability of a research

24 assistant or interpreter to help complete it enabled us to include women who did not speak

25 French and reduced both the risk of selection bias and the missing data rate. The high

26 prevalence of social deprivation and the multicultural cohort recruited in this area is a strength,

27 even though it produces a population not representative of that of France. The choice to build

28 this cohort in this setting was deliberate and consistent with our scientific objectives, in

29 particular to be able to constitute a large group of migrant and undocumented women to allow

30 subgroup analyses. Nevertheless, the substantial number of women excluded for missing data

31 for pregnancy outcomes or with missing questionnaires, or because they gave birth elsewhere

32 or were lost to follow-up, remains a limitation. Because these women were more often

33 underprivileged and born abroad than the final sample (Table S5), we hypothesize that if there

34 is a selection bias, these exclusions may have resulted in underestimating the strength of the

35 association we studied. The relatively limited number of severe maternal morbidity events did

36 not allow us to study this outcome by cause. Information on the legal or illegal status of migrant

37 women was self-reported; the distinction, among legal migrants, between asylum seekers,

38 refugees and other legal status was not collected. Although the prevalence of undocumented

39 women is relatively high, we cannot rule out the possibility that it was underestimated. Finally,

40 despite the fact that information on pre-existing morbidity was collected from medical files in

41 the same way for all groups, it is possible that this information was under-reported in medical

42 files of undocumented migrants, because they are less likely to have adequate medical follow-

43 up and interaction with the health system. Thus the possibility of a differential measurement

44 bias cannot be excluded.

45 ***Interpretation***

46 Our analysis shows that undocumented migrants have a higher risk of severe maternal

47 morbidity than non-migrant women, a risk not explained by a higher rate of baseline at-risk

48 medical conditions and history. One hypothesis that might explain this result is that antenatal

49 care utilisation was inadequate in both quantity and quality. A previous analysis of this study

50 has reported this inadequacy to be more prevalent among undocumented women.[27] This

51 higher risk of inadequate antenatal care utilisation might be explained by the shorter residence

52 and the greater frequency of linguistic barriers, social isolation and poor housing conditions

53 among these women, compared with other categories of migrants. Moreover, 17.6% of

54 undocumented migrants who arrived in France at least 5 months before inclusion were not

55 covered by state medical assistance, although they were legally eligible for this type of aid.

56 The lack of legal status may specifically impair women's ability to interact with the health

57 system and obtain care because of their difficulty in accessing their legal rights. The quality of

58 antenatal care is especially important in screening and monitoring of hypertensive disorders.

59 We found that this pregnancy complication is twice or more as prevalent among undocumented

60 migrants as among non-migrants or legal migrants. These points provide further support to the

61 supposition that antenatal care inadequacy plays a causal role in these disparities. Another

62 explanatory hypothesis is the possibility of an implicit bias related to illegal status that would

63 lead health professionals to provide a lower quality of care to undocumented migrants.[28]

64 Implicit bias related to maternal origin may also explain another finding of our analysis that

65 migrant women born in sub-Saharan Africa, whatever their legal status, are at the highest risk

66 for severe maternal morbidity compared with non-migrants. Indeed, although women from sub-

67 Saharan Africa are more often undocumented, our results show that this only partially explains

68 their higher risk of severe maternal morbidity and suggests that other causal mechanisms exist.

69 Healthcare provision for undocumented migrants could be improved to reduce this higher risk

70 of severe morbidity. Quicker and easier implementation of rights, especially state medical

71 assistance could facilitate access to prenatal care. In addition, implementation of targeted

72 interventions, such as "outreach" approaches[29] to reach out undocumented migrants, or

73 educational programs to strengthen health literacy and empowerment, is essential. This could

74 help migrant women to navigate in a complex healthcare system. Finally, prenatal care

75 utilisation could also be improved in both quantity and quality to make healthcare system more

76 migrant-friendly with the systematic presence of professional translators and the reduction of

77 individual and institutional discriminations[28].

78 **Conclusion**

79 Undocumented migrants, especially those born in sub-Saharan Africa, have the highest risk of

80 severe maternal morbidity, while the prevalence of risk factors does not appear to be higher in

81 this subgroup. Future investigations should assess the extent to which inadequate antenatal

82 care utilisation and healthcare professionals' implicit biases mediate the association between

83   undocumented status and severe maternal morbidity, particularly severe hypertensive

84   complications. Our results support the need to increase healthcare providers' awareness about

85   this group of women at high risk and to improve access to their legal rights.

12   **Disclosure of Interests**

13   None declared. Completed disclosure of interests form available to view online as supporting

14   Information.

15   **Contribution to Authorship**

16   EA, CE, LM, DL and TS conceptualised and developed the methodology for the PreCARE

17   cohort. EA, TS, LM, DL and CE contributed to data acquisition. ME and EA designed the study

18   question and analytic plan. ME, CDT and EA conducted data analysis and generated the tables

19   and figures. ME, CDT, and EA drafted the manuscript. CDT, EA, PS, LM, TS and DL provided

20   analytic oversight and edited the manuscript. All authors have read and agreed to the published

21   version of the manuscript.

22   **Details of ethics approval**

23   The regional ethical review board (CPP-Ile-de-France III, No.09.341bis, date of approval 19

24   November 2009) and the CNIL (Commission Nationale Informatique et Liberté) approved the

25   study. Each woman provided oral informed consent, in compliance with French law.

References

1. Les immigrés récemment arrivés en France [Recent immigrants to France] - Insee Première - 1524. Available from: https://www.insee.fr/fr/statistiques/1281393

2. Institut National de la Statistique et des Etudes Economiques. Les naissances en 2019 [Births in 2019]. 2020. Available from: https://www.insee.fr/fr/statistiques/4647557

3. Zeitlin J, Combier E, Levaillant M, Lasbeur L, Pilkington H, Charreire H, et al. Neighbourhood socio-economic characteristics and the risk of preterm birth for migrant and non-migrant women: a study in a French district. Paediatr Perinat Epidemiol. 2011;25:347–56.

4. Zeitlin J, Bucourt M, Rivera L, Topuz B, Papiernik E. Preterm birth and maternal country of birth in a French district with a multiethnic population. BJOG. 2004;111:849–55.

5. De Jong L, Pavlova M, Winters M, Rechel B. A systematic literature review on the use and outcomes of maternal and child healthcare services by undocumented migrants in Europe. Eur J Public Health. 2017;27:990–7.

6. Saurel-Cubizolles M-J, Saucedo M, Drewniak N, Blondel B, Bouvier-Colle M-H. Santé périnatale des femmes étrangères en France [Perinatal health of foreign women in France]. Bull Épidémiologique Hebd. 2012;2:3–4.

7. Gagnon AJ, Zimbeck M, Zeitlin J. Migration to western industrialised countries and perinatal health: A systematic review. Soc Sci Med. 2009;69:934–46.

8. Pedersen GS, Grøntved A, Mortensen LH, Andersen A-MN, Rich-Edwards J. Maternal Mortality Among Migrants in Western Europe: A Meta-Analysis. Matern Child Health J. 2014;18:1628–38.

9. Van den Akker T, van Roosmalen J. Maternal mortality and severe morbidity in a migration perspective. Best Pract Res Clin Obstet Gynaecol. 2016;32:26–38.

10. Sauvegrain P, Stewart Z, Gonthier C, Saurel-Cubizolles MJ, Saucedo M, Azria E. Accès aux soins prénatals et santé maternelle des femmes immigrés [Women migrants' access to antenatal care and maternal health]. Bulletin Epidémiologique Hebdomadaire; 2017.

11. Almeida LM, Santos CC, Caldas JP, Ayres-de-Campos D, Dias S. Obstetric care in a migrant population with free access to health care. Int J Gynaecol Obstet. 2014;126:244–7.

12. Kandasamy T, Cherniak R, Shah R, Yudin MH, Spitzer R. Obstetric risks and outcomes of refugee women at a single centre in Toronto. J Obstet Gynaecol Can. 2014;36:296–302.

13. Philibert M, Deneux-Tharaux C, Bouvier-Colle M-H. Can excess maternal mortality among women of foreign nationality be explained by suboptimal obstetric care? BJOG Int J Obstet Gynaecol. 2008;115:1411–8.

14. Deneux-Tharaux C, Saucedo M. Epidemiology of maternal mortality in France, 2010-2012. Gynecol Obstet Fertil Senol. 2017;45:S8–21.

15. Boulkedid R, Sibony O, Bossu-Salvador C, Oury J, Alberti C. Monitoring healthcare quality in an obstetrics and gynaecology department using a CUSUM chart: CUSUM to monitor quality indicators in obstetrics. BJOG. 2010;117:1225–35.

16. Azria E, Stewart Z, Gonthier C, Estellat C, Deneux-Tharaux C. Inégalités sociales de santé maternelle [Social inequalities of maternal health]. Gynécologie Obstétrique Fertil. 2015;43:676–682.

17. Heslehurst N, Brown H, Pemu A, Coleman H, Rankin J. Perinatal health outcomes and care among asylum seekers and refugees: a systematic review of systematic reviews. BMC Med. 2018;16. Available on: https://www.ncbi.nlm.nih.gov/pmc/articles/PMC5996508/

18. Gieles NC, Tankink JB, van Midde M, Düker J, van der Lans P, Wessels CM, et al. Maternal and perinatal outcomes of asylum seekers and undocumented migrants in Europe: a systematic review. Eur J Public Health. 2019;29:714-23.

19. Almeida LM, Caldas J, Ayres-de-Campos D, Salcedo-Barrientos D, Dias S. Maternal healthcare in migrants: a systematic review. Matern Child Health J. 2013;17:1346–54.

20. Van Hanegem N, Miltenburg AS, Zwart JJ, Bloemenkamp KWM, Van Roosmalen J. Severe acute maternal morbidity in asylum seekers: a two-year nationwide cohort study in the Netherlands: Severe maternal morbidity in asylum seekers. Acta Obstet Gynecol Scand. 2011;90:1010–6.

21. European border and coast guard agency. Annual Risk Analysis 2014. Available from: https://frontex.europa.eu/assets/Publications/Risk_Analysis/Annual_Risk_Analysis_201 4.pdf

22. Gonthier C, Estellat C, Deneux-Tharaux C, Blondel B, Alfaiate T, Schmitz T, et al. Association between maternal social deprivation and prenatal care utilization: the PreCARE cohort study. BMC Pregnancy Childbirth. 2017;17. Available from: http://bmcpregnancychildbirth.biomedcentral.com/articles/10.1186/s12884-017-1310-z

23. Linard M, Blondel B, Estellat C, Deneux-Tharaux C, Luton D, Oury J, et al. Association between inadequate antenatal care utilisation and severe perinatal and maternal morbidity: an analysis in the PreCARE cohort. BJOG. 2018;125:587–95.

24. Haute Autorité de Santé. [Follow-up and orientation of pregnant women regarding identified risk situations. Professional guidelines: a synthesis]. Gynecol Obstet Fertil. janv 2008;36:111-4.

25. Ananth CV, Schisterman EF. Confounding, causality, and confusion: the role of intermediate variables in interpreting observational studies in obstetrics. Am J Obstet Gynecol. 2017;217:167–75.

26. RJ Little, Rubin DB. Statistical Analysis with Missing Data, 3rd Edition. Hoboken, New Jersey: John Wiley & Sons; 2019.

27. Eslier M, Deneux-Tharaux C, Sauvegrain P, Schmitz T, Luton D, Mandelbrot L, et al. Association between Migrant Women's Legal Status and Prenatal Care Utilization in the PreCARE Cohort. Int J Environ Res Public Health. 2020;17.

28. Sauvegrain P, Azria E, Chiesa-Dubruille C, Deneux-Tharaux C. Exploring the hypothesis of differential care for African immigrant and native women in France with hypertensive disorders during pregnancy: a qualitative study. BJOG. 2017;124:1858-65.

29. Bonevski B, Randell M, Paul C, Chapman K, Twyman L, Bryant J, et al. Reaching the hard-to-reach: a systematic review of strategies for improving health and medical research with socially disadvantaged groups. BMC Med Res Methodol. 2014;14:42.

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Table S1. Categories of women's legal status and corresponding definitions

Categories of legal status	Definitions
Non-migrants	- Women born in France
Legal migrants with French or European citizenship	- Women born outside France, AND reporting a French or other European citizenship.

Other legal migrants	- Women born outside France, with a non-European citizenship AND holding a regularisation issued by French or European authorities :
	   o a residence permit, which is an authorization allowing a migrant who has been in the country for more than 3 months to stay in France. It can be issued to migrants for family ties, for services rendered to France or for protection granted, including refugees. It is valid for 10 years and is renewable. Asylum seekers have a legal status while their case is being processed.
	   o OR a temporary residence permit, which is available under conditions to migrants with family in France, to migrants coming to work in France, to seasonal workers, to workers on assignment in France in a company of the group that employs them abroad, and to students after a one-year long-stay visa. It is valid from 1 to 4 years maximum,
	   o OR a long-term tourist visa, which is valid from 4 to 12 months with the same conditions as a temporary residence permit,
	   o OR a short-term tourist visa which is valid maximum 3 months.

Undocumented migrants	- Women born outside France, with a non-European citizenship AND
	   o awaiting a decision about their legal status (regularisation and residence permit),
	   o OR on expiry of their visa or residence permit,
	   o OR with a negative response to their application for regularisation.

Directed acyclic graph.

Study population selection.

Number of women giving birth in the 4 maternity units: N_1 = 10576

$N_{1'}$ = **157 (1.5%)** refusal to participate

Number of women included in the PreCARE cohort: N_2 = 10419

$N_{2'}$ = 201 (1.9%)
- 60 women mistakenly included
- 135 terminations and fetal losses before 21 completed weeks of pregnancy
- 6 withdrawals of consent

Population of interest

N_4 = 10218 women

$N_{3'}$ = 619 (6.1%)
- 209 deliveries in other maternity units
- 378 lost to follow-up
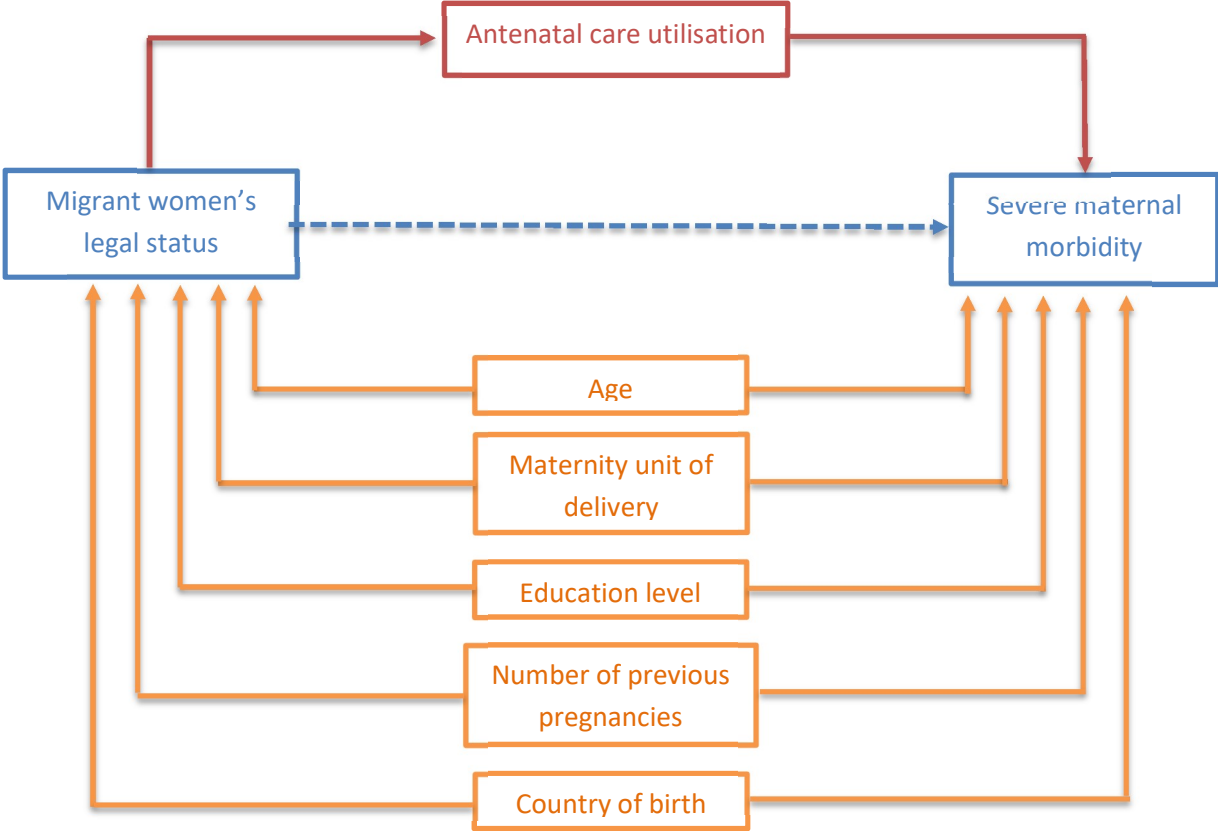- 32 women with missing questionnaires

Study population

N_5 = 9599 women

Table S2. Severe maternal morbidity rates according to the woman's legal status and birthplace

	All women		Non-migrants		Legal migrants with French or European citizenship born in a non-sub-Saharan African country		Legal migrants with French or European citizenship born in sub-Saharan Africa		Other legal migrants born in a non-sub-Saharan African country		Other legal migrants born in sub-Saharan Africa		Undocumented migrants born in a non-sub-Saharan African country		Undocumented migrants born in sub-Saharan Africa	
	(n = 9 599)		(n = 4 523)		(n = 1 174)		(n = 381)		(n = 1 929)		(n = 877)		(n = 407)		(n = 308)	
	n	%	n	%	n	%	n	%	n	%	n	%	n	%	n	%
Severe hypertensive disorder of pregnancy *	95	1.0	44	1.0	5	0.4	4	1.1	16	0.8	12	1.4	5	1.2	9	2.9
Severe postpartum haemorrhage	56	0.6	22	0.5	9	0.8	0	0.0	11	0.6	9	1.0	2	0.5	3	1.0
Perineal trauma grade 3 or 4	58	0.6	27	0.6	2	0.2	1	0.3	19	1.0	5	0.6	3	0.7	1	0.3
Surgical re-intervention	53	0.6	25	0.6	5	0.4	4	1.1	11	0.6	4	0.5	0	0.0	4	1.3
Maternal admission to intensive care unit	57	0.6	24	0.5	8	0.7	3	0.8	8	0.4	9	1.0	3	0.7	2	0.7
Deep venous thrombosis or pulmonary embolism	25	0.3	9	0.2	3	0.3	1	0.3	7	0.4	1	0.1	1	0.3	3	1.0
Convulsions (excluding eclampsia)	13	0.1	5	0.1	2	0.2	1	0.3	4	0.2	0	0.0	1	0.3	0	0.0
Placental abruption except for severe hypertensive disorder of pregnancy	12	0.1	3	0.1	2	0.2	0	0.0	2	0.1	2	0.2	1	0.3	2	0.7
Uterine rupture	10	0.1	2	0.0	1	0.1	0	0.0	3	0.2	1	0.1	2	0.5	1	0.3
Diabetic ketoacidosis	7	0.1	2	0.0	1	0.1	0	0.0	3	0.2	0	0.0	1	0.3	0	0.0
Severe sepsis	6	0.1	1	0.0	0	0.0	1	0.3	3	0.2	0	0.0	1	0.3	0	0.0
Haemorrhagic shock	6	0.1	1	0.0	2	0.2	1	0.3	0	0.0	2	0.2	0	0.0	0	0.0
Maternal death	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
**Severe maternal morbidity **	**304**	**3.2**	**129**	**2.9**	**29**	**2.5**	**12**	**3.2**	**67**	**3.5**	**34**	**3.9**	**15**	**3.7**	**18**	**5.8**

* Severe hypertensive disorder of pregnancy is defined as the presence of severe preeclampsia, eclampsia or placental abruption in the context of a pregnancy-related hypertensive disorder.

** Severe maternal morbidity was defined by at least one of the above complications up to 42 days postpartum, non-exclusive categories.

Table S3. Risk of severe maternal morbidity according to the woman's legal status – Multivariable analysis with complete cases versus multiple imputation.

	Severe maternal morbidity*	
	Complete cases (n = 9213)	Multiple imputation (n = 9599)
	aOR [95% CI][1]	aOR [95% CI][1]
Non-migrants (n = 4523)	1	1
Legal migrants with French or European citizenship (n = 1555)	1.01 [0.80 - 1.45]	0.94 [0.66 - 1.35]
Other legal migrants (n = 2806)	1.40 [1.05 - 1.85]	1.35 [1.03 - 1.79]
Undocumented migrants (n = 715)	1.76 [1.15 - 2.68]	1.68 [1.12 - 2.53]

OR, odds ratio; aOR, adjusted odds ratio; CI, Confidence interval.

* Severe maternal morbidity (SMM) was defined by at least one of the following items: Severe hypertensive disorder of pregnancy (presence of severe preeclampsia [systolic blood pressure > 160 mm Hg, diastolic blood pressure > 110 mm Hg, or hypertension with general signs, and one or more of the following: proteinuria >3.5 g/24 hours, serum creatinine >100 µmol/l, diuresis <20 ml/hour, haemolysis, aspartate transaminase > 3N, thrombocytopaenia <100 000/mm3, or before 32 weeks], eclampsia or placental abruption in the context of a pregnancy-related hypertensive disorder), severe postpartum haemorrhage (second-line uterotonic treatment associated with transfusion of at least two units of packed red blood cells, and/or uterine artery ligation, and/or uterine compressive sutures, and/or embolisation and/or hysterectomy), grade 3 or 4 perineal trauma, surgical reintervention, maternal admission to intensive care unit, deep venous thrombosis or pulmonary embolism, convulsions (excluding eclampsia), placental abruption except for severe hypertensive disorder of pregnancy, uterine rupture, diabetic ketoacidosis, severe sepsis (sepsis with organ failure), haemorrhagic shock, or maternal death.

[1] Logistic regression model adjusted for maternal age, education level, number of previous pregnancies and maternity unit of delivery.

Table S4. Risk of severe maternal morbidity according to the woman's legal status and birthplace, sensitivity analysis after exclusion of women who arrived in France less than 12 months before delivery and who started their antenatal care in France after 14 weeks of gestation.

	Severe maternal morbidity*	
	OR [95% CI]	aOR [95% CI][1]
Non-migrants (n = 3874)	1	1
Legal migrants with French or European citizenship (n = 1288)	0.85 [0.57 - 1.27]	0.96 [0.64 - 1.44]
Other legal migrants (n = 2075)	1.17 [0.87 - 1.59]	1.34 [0.97 - 1.86]
Undocumented migrants (n = 413)	1.81 [1.12 - 2.92]	1.96 [1.18 - 3.27]
Non-migrants (n = 3874)	1	1
Legal migrants with French or European citizenship born outside sub-Saharan Africa (n = 972)	0.92 [0.60 - 1.42]	1.00 [0.64 - 1.55]
Legal migrants with French or European citizenship born in sub-Saharan Africa (n = 316)	0.64 [0.28 - 1.47]	0.81 [0.35 - 1.89]
Other legal migrants born outside sub-Saharan Africa (n = 1440)	1.21 [0.86 - 1.70]	1.35 [0.95 - 1.92]
Other legal migrants born in sub-Saharan Africa (n = 635)	1.09 [0.67 - 1.77]	1.33 [0.79 - 2.25]
Undocumented migrants born outside sub-Saharan Africa (n = 254)	1.37 [0.71 - 2.65]	1.49 [0.75 - 2.94]
Undocumented migrants born in sub-Saharan Africa (n = 159)	2.57 [1.35 - 4.88]	2.80 [1.42 - 5.53]

OR, odds ratio; aOR, adjusted odds ratio; CI, Confidence interval.

* Severe maternal morbidity (SMM) was defined by at least one of the following items: Severe hypertensive disorder of pregnancy (presence of severe preeclampsia [systolic blood pressure > 160 mm Hg, diastolic blood pressure > 110 mm Hg, or hypertension with general signs, and one or more of the following: proteinuria >3.5 g/24 hours, serum creatinine >100 μmol/l, diuresis <20 ml/hour, haemolysis, aspartate transaminase > 3N, thrombocytopaenia <100 000/mm3, or before 32 weeks], eclampsia or placental abruption in the context of a pregnancy-related hypertensive disorder), severe postpartum haemorrhage (second-line uterotonic treatment associated with transfusion of at least two units of packed red blood cells, and/or uterine artery ligation, and/or uterine compressive sutures, and/or embolisation and/or hysterectomy), grade 3 or 4 perineal trauma, surgical reintervention, maternal admission to intensive care unit, deep venous thrombosis or pulmonary embolism, convulsions (excluding eclampsia), placental abruption except for severe hypertensive disorder of pregnancy, uterine rupture, diabetic ketoacidosis, severe sepsis (sepsis with organ failure), haemorrhagic shock, or maternal death.

[1] Logistic regression model adjusted for maternal age, education level, number of previous pregnancies and maternity unit of delivery.

<u>Table S5.</u> Comparison of the characteristics of women included and excluded from the study population.

	Study population (n = 9599)		Women excluded (n = 619)	
	n	%	n	%
Women's legal status				
Non-migrants	4523	47.1	277	44.7
Legal migrants with French or European citizenship	1555	16.2	93	15.0
Other legal migrants	2806	29.2	154	24.9
Undocumented migrants	715	7.4	54	8.7
Missing data	*0*	*0.0*	*41*	*6.6*
Maternal birthplace				
Metropolitan France	4363	45.5	262	42.4
French overseas	166	1.7	15	2.4
Europe (others)	467	4.9	38	6.1
North Africa	2116	22.0	103	16.6
Sub-Saharan Africa	1566	16.3	115	18.6
Asia - Middle East	626	6.5	27	4.4
Others	295	3.1	59	9.5
Missing data	*0*	*0.0*	*0*	*0.0*
Maternal age (years)				
< 20	128	1.3	19	3.1
[20 - 25[	1303	13.6	99	16.0
[25 - 30[	2912	30.3	184	29.7
[30 - 40[	4793	49.9	271	43.8
≥ 40	463	4.8	46	7.4
Missing data	*0*	*0.0*	*0*	*0.0*
Living alone	1409	14.7	130	21.0
Missing data	*27*	*0.3*	*41*	*6.6*
Deprivation index * :				
0 criterion	6322	65.9	340	54.9
1 criterion	1681	17.5	97	15.7
2 criteria	839	8.7	66	10.7
3 or 4 criteria	660	6.9	67	10.8
Missing data	*97*	*1.0*	*49*	*7.9*
Education level				
≤ Primary school	667	6.9	37	6.0
Middle school	1746	18.2	98	15.8
High school	2299	24.0	124	20.0
University	4792	49.9	318	51.4
Missing data	*95*	*1.0*	*42*	*6.8*
Social welfare coverage				
Standard health insurance	1368	14.3	86	13.9
Complementary health insurance	6001	62.5	338	54.6
Universal health coverage	1191	12.4	69	11.1
State medical assistance	586	6.1	38	6.1
No healthcare insurance	367	3.8	38	6.1
Missing data	*86*	*0.9*	*50*	*8.1*

* Deprivation index: simple sum of 4 deprivation dimensions: Social isolation, Poor or insecure housing condition, No work-related household income, and No permanent heath care insurance

Table 1. Women's baseline characteristics according to their legal status (N=9599).

Legal Status (N = 9 599)	Non-migrants (n = 4523)		Legal migrants with French or European citizenship (n = 1555)		Other legal migrants (n = 2806)		Undocumented migrants (n = 715)		p ****
	n	%	n	%	n	%	n	%	
Age (years)									< 0.001
< 20	76	1.7	13	0.8	26	0.9	13	1.8	
[20 – 25[	606	13.4	188	12.1	375	13.4	134	18.7	
[25 – 30[	1428	31.6	362	23.3	871	31.0	251	35.1	
[30 – 35[	1553	34.3	503	32.4	861	30.7	191	26.7	
[35 – 40[	702	15.5	361	23.2	518	18.5	104	14.6	
≥ 40	158	3.5	128	8.2	155	5.5	22	3.1	
Social isolation	77	1.7	55	3.5	172	6.1	123	17.2	< 0.001
Poor or insecure housing condition	412	9.1	175	11.3	510	18.2	406	56.8	< 0.001
No standard health care insurance	396	8.8	276	17.7	833	29.7	639	89.4	< 0.001
No work-related household income	435	9.6	194	12.5	520	18.5	335	46.9	< 0.001
Deprivation index *									< 0.001
0 criterion	3661	80.9	1087	69.9	1574	56.1	0	0.0	
1 criterion	515	11.4	293	18.8	667	23.8	206	28.8	
2 criteria	240	5.3	117	7.5	337	12.0	145	20.3	
3 or 4 criteria	103	2.3	55	3.5	216	7.7	286	40.0	
Education level									< 0.001
≤ Primary school	32	0.7	88	5.7	391	13.9	156	21.8	
Middle school	643	14.2	297	19.1	633	22.6	173	24.2	
High school	892	19.7	419	26.9	793	28.3	195	27.3	
University	2943	65.1	736	47.3	943	33.6	170	23.8	
Social welfare coverage at inclusion									< 0.001
Standard health insurance (SHI)	429	9.5	264	17.0	675	24.1	0	0.0	
SHI + Complementary health insurance	3695	81.7	1013	65.1	1293	46.1	0	0.0	
Universal health coverage (CMU)	366	8.1	218	14.0	607	21.6	0	0.0	
State medical assistance (AME)	1	0.0	22	1.4	90	3.2	473	66.2	
No healthcare insurance	29	0.6	36	2.3	136	4.8	166	23.2	
Maternal birthplace									< 0.001
Metropolitan France	4357	96.3	0	0.0	0	0.0	6	0.8	
French overseas	166	3.7	0	0.0	0	0.0	0	0.0	
Europe (others)	0	0.0	339	21.8	77	2.7	51	7.1	
North Africa	0	0.0	611	39.3	1314	46.8	191	26.7	
Sub-Saharan Africa	0	0.0	381	24.5	877	31.3	308	43.1	
Asia - Middle East	0	0.0	138	8.8	379	13.6	109	15.2	
Others	0	0.0	86	5.5	159	5.7	50	7.0	
Length of residency (median in months)**	NA	NA	141.4		71.9		31.6		< 0.001
IQR 25/75			82.7	250.6	26.0	118.8	9.4	73.4	
Linguistic barrier	41	0.9	150	9.6	575	20.5	241	33.7	< 0.001
Smoker before pregnancy	1237	27.3	206	13.2	138	4.9	45	6.3	< 0.001
Smoker during pregnancy	644	14.2	113	7.3	66	2.4	21	2.9	< 0.001
Alcohol during pregnancy	372	8.2	96	6.2	134	4.8	61	8.5	< 0.001
Drugs during pregnancy	39	0.9	5	0.3	6	0.2	1	0.1	< 0.001

	n	%	n	%	n	%	n	%	p****
Body mass index (kg/m²)									**< 0.001**
< 18.5	303	6.7	76	4.9	122	4.3	46	6.4	
18.5 – 24.9	2844	62.9	864	55.6	1361	48.5	318	44.5	
25 – 29.9	767	17.0	366	23.5	733	26.1	167	23.4	
≥ 30	505	11.2	187	12.0	376	13.4	80	11.2	
Obstetric history									
Nulliparous	2302	50.9	520	33.4	963	34.3	332	46.4	**< 0.001**
Previous caesarean section	178	3.9	127	8.2	253	9.0	33	4.6	**< 0.001**
Voluntary abortion	974	21.5	308	19.8	505	18.0	137	19.2	**< 0.001**
Ectopic pregnancy	90	2.0	33	2.1	54	1.9	10	1.4	0.6
Late miscarriage	49	1.1	29	1.9	48	1.7	13	1.8	**0.04**
Gestational diabetes	136	3.0	72	4.6	148	5.3	12	1.7	**< 0.001**
Pregnancy-related hypertensive disorder	99	2.2	54	3.5	80	2.9	7	1.0	**0.02**
Fetal growth restriction	62	1.4	23	1.5	49	1.7	8	1.1	0.5
Preterm delivery	218	4.8	97	6.2	169	6.0	37	5.2	0.06
Postpartum haemorrhage	59	1.3	36	2.3	62	2.2	12	1.7	0.1
Fetal or neonatal death	100	2.2	41	2.6	79	2.8	29	4.1	**0.03**
High risk at the beginning of pregnancy***	925	20.5	297	19.1	521	18.6	124	17.3	0.1
Gestational age at delivery									0.4
< 32 weeks of gestation	95	2.1	32	2.1	52	1.9	11	1.5	
[32-37[weeks of gestation	327	7.2	108	6.9	166	5.9	45	6.3	
≥ 37 weeks of gestation	4101	90.7	1415	91.0	2588	92.2	659	92.2	
Mode of delivery									**< 0.001**
Vaginal delivery	3684	81.5	1226	78.8	2209	78.7	516	72.2	
Caesarean section	821	18.2	319	20.5	585	20.8	194	27.1	

IQR, interquartile range; NA, not applicable; the sum is not equal to 100% due to missing data

* Deprivation index: simple sum of 4 deprivation dimensions: Social isolation, Poor or insecure housing condition, No work-related household income, and No permanent heath care insurance

** If born abroad

*** High-risk at the beginning of pregnancy is defined by at least one of the following items in accordance with French guidelines: history of cardiac disease, hypertension, diabetes, venous thrombosis, pulmonary embolism, Graves' disease, asthma, homozygous sickle cell, anaemia, thrombocytopaenia, coagulation disorder, a rare or systemic disease, nephropathy, HIV infection, late miscarriage, preeclampsia, fetal growth restriction, preterm delivery, fetal death or neonatal death

**** Chi² test (or Fisher's exact test if necessary) for qualitative variables and Kruskal–Wallis test for medians of quantitative variables

Table 2. Severe maternal morbidity rates according to the woman's legal status.

	All women (n = 9599)		Non-migrants (n = 4523)		Legal migrants with French or European citizenship (n = 1555)		Other Legal migrants (n = 2806)		Undocumented migrants (n = 715)	
	n	%	n	%	n	%	n	%	n	%
Severe hypertensive disorder of pregnancy *	95	1.0	44	1.0	9	0.6	28	1.0	14	2.0
Severe postpartum haemorrhage	56	0.6	22	0.5	9	0.6	20	0.7	5	0.7
Perineal trauma grade 3 or 4	58	0.6	27	0.6	3	0.2	24	0.9	4	0.6
Surgical re-intervention	53	0.6	25	0.6	9	0.6	15	0.5	4	0.6
Maternal admission to intensive care unit	57	0.6	24	0.5	11	0.7	17	0.6	5	0.7
Deep venous thrombosis or pulmonary embolism	25	0.3	9	0.2	4	0.3	8	0.3	4	0.6
Convulsions (excluding eclampsia)	13	0.1	5	0.1	3	0.2	4	0.1	1	0.1
Placental abruption except for severe hypertensive disorder of pregnancy	12	0.1	3	0.1	2	0.1	4	0.1	3	0.4
Uterine rupture	10	0.1	2	0.0	1	0.1	4	0.1	3	0.4
Diabetic ketoacidosis	7	0.1	2	0.0	1	0.1	3	0.1	1	0.1
Severe sepsis	6	0.1	1	0.0	1	0.1	3	0.1	1	0.1
Haemorrhagic shock	6	0.1	1	0.0	3	0.2	2	0.1	0	0.0
Maternal death	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
**Severe maternal morbidity **	**304**	**3.2**	**129**	**2.9**	**41**	**2.6**	**101**	**3.6**	**33**	**4.6**

* Severe hypertensive disorder of pregnancy is defined as the presence of severe preeclampsia, eclampsia or placental abruption in the context of a pregnancy-related hypertensive disorder.

** Severe maternal morbidity was defined by at least one of the above complications up to 42 days postpartum, non-exclusive categories.

Table 3. Risk of severe maternal morbidity according to the woman's legal status and birthplace.

	Severe maternal morbidity*	
	OR [95% CI]	aOR [95% CI][1]
Non-migrants (n = 4 523)	1	1
Legal migrants with French or European citizenship (n = 1 555)	0.93 [0.65 – 1.33]	0.94 [0.66 - 1.35]
Other legal migrants (n = 2 806)	1.28 [0.98 – 1.67]	1.35 [1.03 - 1.79]
Undocumented migrants (n = 715)	1.67 [1.13 – 2.47]	1.68 [1.12 - 2.53]
Non-migrants (n = 4 523)	1	1
Legal migrants with French or European citizenship born outside sub-Saharan Africa (n = 1 174)	0.87 [0.58 - 1.31]	0.93 [0.61 - 1.40]
Legal migrants with French or European citizenship born in sub-Saharan Africa (n = 381)	1.10 [0.60 - 2.01]	1.31 [0.71 - 2.42]
Other legal migrants born outside sub-Saharan Africa (n = 1 929)	1.23 [0.91 - 1.66]	1.33 [0.97 - 1.82]
Other legal migrants born in sub-Saharan Africa (n = 877)	1.39 [0.94 - 2.04]	1.62 [1.07 - 2.47]
Undocumented migrants born outside sub-Saharan Africa (n = 407)	1.32 [0.77 - 2.28]	1.44 [0.82 - 2.53]
Undocumented migrants born in sub-Saharan Africa (n = 308)	2.15 [1.29 - 3.57]	2.26 [1.30 - 3.91]

OR, odds ratio; aOR, adjusted odds ratio; CI, Confidence interval.

* Severe maternal morbidity (SMM) was defined by at least one of the following items: Severe hypertensive disorder of pregnancy (presence of severe preeclampsia [systolic blood pressure > 160 mm Hg, diastolic blood pressure > 110 mm Hg, or hypertension with general signs, and one or more of the following: proteinuria >3.5 g/24 hours, serum creatinine >100 µmol/l, diuresis <20 ml/hour, haemolysis, aspartate transaminase > 3N, thrombocytopaenia <100 000/mm3, or before 32 weeks], eclampsia or placental abruption in the context of a pregnancy-related hypertensive disorder), severe postpartum haemorrhage (second-line uterotonic treatment associated with transfusion of at least two units of packed red blood cells, and/or uterine artery ligation, and/or uterine compressive sutures, and/or embolisation and/or hysterectomy), grade 3 or 4 perineal trauma, surgical reintervention, maternal admission to intensive care unit, deep venous thrombosis or pulmonary embolism, convulsions (excluding eclampsia), placental abruption except for severe hypertensive disorder of pregnancy, uterine rupture, diabetic ketoacidosis, severe sepsis (sepsis with organ failure), haemorrhagic shock, or maternal death.

[1] Logistic regression model adjusted for maternal age, education level, number of previous pregnancies and maternity unit of delivery.